Underlying uncertainty in future projection of iron deposition to the ocean

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Global models have been used to deduce iron deposition, but the uncertainty remains large. We used a global chemical transport model to investigate the effect of the estimated size distribution of dust on the bioavailable iron deposition. Simulations are performed with six different size distributions for dust aerosols at emission using similar aerosol optical depths (AODs) to constrain the total emission flux of dust. The global dust emission rate using a recent theoretical estimate for the dust size distribution at emission is about two times larger than the average of estimates using the other four empirical size distributions. In contrast to the large differences in total emissions, the emission of fine dust (diameter < 2.5 μm) is relatively robust, due to the strong constraint of AOD on fine dust emission. Our model results indicate that soluble iron (SFe) deposition is relatively invariant to the dust size distribution at emission in regions where most soluble iron is provided by acid mobilization of fine dust. In contrast, the use of the theoretical size distribution suggests a larger deposition of SFe in regions where the concentration of acidic gases is insufficient to promote iron dissolution in dust particles, such as the South Atlantic. These results could have important implications for the projection of marine ecosystem feedbacks to climate change and highlight the necessity to improve the dust size distribution.

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